Quarterly Progress Report
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Period of Report: April 2013, through June 2013.

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Introduction

The debris mitigation project goals are to:

(1) Develop a test debris mitigation platform that will allow us to test various debris mitigation technologies and methods. (completed)
(2) Prepare the Nenana test site infrastructure (e.g., anchoring/mooring system) to be able to accommodate the debris mitigation platform tests (completed) and possibly retest the New Energy Turbine, as appropriate (Cost estimates to refurbish the New Energy Turbine and our work on debris testing indicates that it is beyond the scope of this project).
(3) Obtain necessary permits and conduct the necessary baseline studies to prepare for the debris mitigation testing. (completed)
(4) Conduct the debris mitigation technology and debris management methods testing (completed).

Note: With all major tasks of the project completed we are now analyzing data with the intention of completing project reports and providing recommendations on debris mitigation technology and methods.

Refer to previous quarterly reports for a general description of the project and activities to-date. Previous quarterly reports were submitted on 10/15/2011, 1/16/2012, 4/3/2012, 7/24/2012, 10/18/2012, 1/15/2012, and 4/27/2013.

Activities and Progress

During April through June we continued analyzing current flow data behind the Research Debris Diversion Platform (RDDP) (refer to the 4/27/2013 progress report for details) and started analysis of debris interaction with the RDDP. We also conducted a preliminary examination of debris interaction with the RDDP using a discrete element method to simulate debris interaction with the RDDP (this effort may be abandoned if it proves too time consuming or difficult).

The analysis of debris interaction videos are being done to determine how well the RDDP diverts debris and to estimate how far behind the RDDP that the channel remains clear of debris. The distance behind the RDDP that remains clear of debris is important in determining how far behind an RDDP that a river energy conversion system (RECS) can be moored without debris back filling behind the RDDP to pose a hazard to the RECS. The farther that a RECS is moored behind the RDDP the less effect that turbulence generated by the RDDP will have on RECS performance. The turbulence channel behind the RDDP can be seen in Figures 1 and 2 along with debris objects that have been deflected by the RDDP. From the location of the debris in the figures, it appears that the debris remains on the edge of the turbulence zone behind the RDDP for quite a long distance downstream from the RDDP. This indicates that it may be possible for RECS to be tethered downstream from the RDDP for quite a distance, to reduce the influence of RDDP turbulence on RECS performance. The video recording of the debris motion shown in the figures provides even stronger evidence that once the debris is diverted around the RDDP it remains out of the flow channel immediately behind the RDDP for a significant distance downstream.

As part of the debris impact tests conducted on the RDDP last summer (2012) we had replaced the freely rotating cylinder with an angled nose that was covered with high density/low friction plastic in an effort to examine the performance difference between the angled front-end compared to the cylinder front-end. Analysis of the video of debris impact tests against the RDDP demonstrate that debris that impacts the angle front-end have a very high probability of remaining caught on the front-end part of the RDDP (Figure 3). We hypothesis that this occurs because the apex of the angle indents in to the debris object preventing it from sliding off the angle even when to debris object has a torque imbalance about the angle apex. Instead of sliding off the angle, the debris object rotates around its point of contact with the angle apex. These results provide further evidence that the freely rotating cylinder front-end covered with high-density plastic is the most effective method of preventing debris from hanging up on the front of the RDDP.

Planned activities for the next quarter

During the next quarter we will continue analyzing ADCP data to determine the effect of the RDDP on current flow velocities and turbulence, continue developing conceptual and physical models of RDDP interactions with debris, and analyzing the video data to ascertain the processes of debris diversion and behavior. We will also begin preparing the project final report.

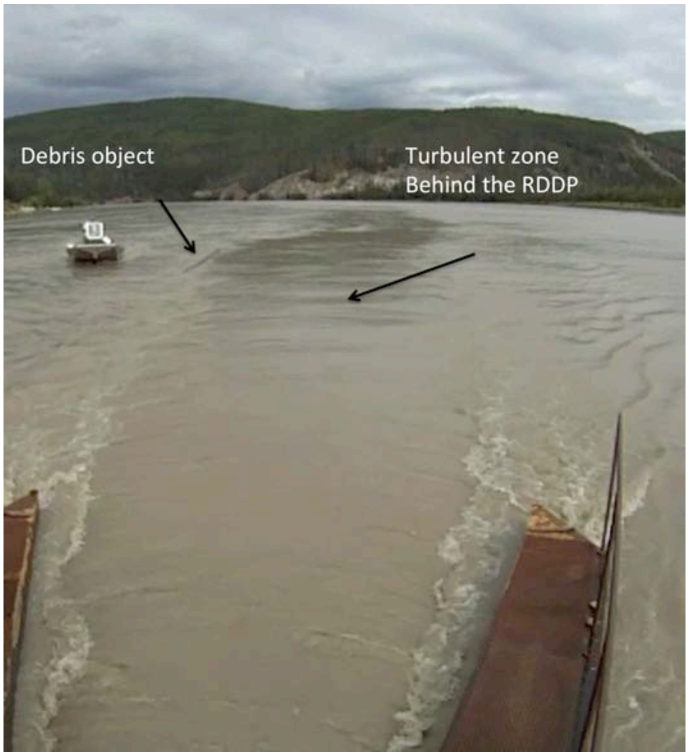

Figure 1. Debris object behind the RDDP after being diverted. Note its position on the edge of the turbulent zone in the flow path immediately behind the RDDP.


Figure 2. Debris objects on both sides of the RDDP after being diverted at the edge of the RDDP turbulent flow path.

Figure 3. Debris object pinned against the angle front-end on the RDDP